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ISOLDE AND NEUTRON TIME-OF-FLIGHT EXPERIMENTS COMMITTEE

Minutes of the 32nd meeting of the INTC
Held on Monday 3 and Tuesday 4 November 2008

OPEN SESSION

Monday 3 November 2008 at 13:30 h, Council Chamber

The Chairman of the INTC, Mark Huyse, opened the meeting and introduced the new members of the Committee, Patricia Roussel Chomaz and Nigel Orr, and thanked the previous members Yorick Blumenfeld and Philippe Chomaz. He congratulated everybody involved in the Physics program at ISOLDE for the so far successful running period with still a few more experiments to take place. He then announced the agenda of the open session.

ISOLDE Technical Report

The AB-ISOLDE representative for the INTC, Mats Lindroos, summarized the technical activities during the running period 2008. One of the main problems in 2007 was the increase in activated air being released through the stack of ISOLDE, which led to a decrease of the proton beam current to 1 μA in order to stay below the allowed limit of activated air. Several tests had been done in the shutdown and in the beginning of the 2008 running period in order to solve this problem. After the change of the ventilation direction in the target zone and additional measurements, the observed amount of activated air was finally comparable to previous data and a new limit of activated-air release of 650 kBq/m^3 was put in place to have again a maximum of 2 μA of proton beam current on both target stations.

A new tape station system was installed at the LA2 beam line (in collaboration with IPHC Strasbourg), which will be tested in parallel to the present ISOLDE tape station for commissioning and calibration. The Committee was also informed on the successful operation of the new ISCOOL cooler and buncher, which has a transmission efficiency of more than 80% for nuclide masses above A=40. The device has been fully integrated into the existing control system, with the vacuum controls still to be added. In the shutdown a new rf amplifier will be installed for better performance in case of the very heavy nuclides. Also the bunch-mode operation was very successful this year and further tests are planned in the future.

The REX-ISOLDE campaign 2008 had seven runs with some new milestones, i.e. the first carbon beam, ^{61}Fe isotopes produced by in-trap decay of ^{61}Mn in the EBIS and post-accelerated for MINIBALL, ^{202,204}Rn as heaviest radioactive isotope so far, and a 10-day long ^{30}Mg run for two-neutron transfer with a tritium target at MINIBALL. The total efficiency for the low-energy part of REX-ISOLDE was partly above 10%, for the heavy masses about 5%. The Committee was also informed that in the shutdown some elements of the REX-ISOLDE beam line will be

modified in order to improve the beam transport. Furthermore, the rf-room cooling will be improved and the REX-TRAP consolidation is ongoing. Also the pulsed injection from the ISCOOL RFQ into REX-TRAP was tested which also allowed one to further test the mass resolution in REX-TRAP. For the HIE-ISOLDE project a short report on the HIE-LINAC design was then given. It is planned to have a staged construction to avoid interruption of the beam delivery and the first results on the cavity development are expected in February 2009.

Finally, an overview on the target and ion-source development was presented. A new FEBIAD ion source showed an up to 10 times higher ionization efficiency for noble gases and new nano-grained target materials like Y_2O_3 led to higher production yields for ^{72}Kr and ^{9}C. Also the new solid state lasers gave higher ionization efficiencies and showed a reliable operation throughout the year. New schemes have been tested and others improved. About 60% of the RILIS operation in 2008 was covered by the new solid state lasers. The Committee was informed that end of the year a large number of AB/ATB-IF group members will leave (end of PhD or retirement) and only a few new group members could be welcomed. Without further manpower the target and ion-source development might be hampered next year.

ISOLDE Physics Report

The ISOLDE Physics Coordinator, Alexander Herlert, gave an overview of the schedule and the running period 2008. The CERN accelerator schedule of 2008 allowed one to have 27 weeks of on-line physics runs at ISOLDE with protons from the PS Booster from May 5 until November 12. The stop of the ISOLDE facility is planned for December 5 in order to include some off-line tests and runs before the Christmas shutdown.

For the 2008 on-line schedule, 470 approved RIB shifts were left after the 2007 running period and in the February meeting another 231 RIB shifts were approved giving in total 701 RIB shifts which could be requested. The additional 120 RIB shifts from the May INTC meeting were not taken into account for scheduling. In total 551 RIB shifts were requested by 46 ISOLDE experiments from which 358 RIB shifts could be scheduled for 31 experiments (some with different beams). Additional shifts were reserved for target and ion-source development and machine development for REX-ISOLDE and the new ISCOOL RFQ cooler and buncher. Especially for the ISCOOL buncher an additional day for the setup of each target was added to the HRS schedule.

After a difficult start of the running period (as presented at the last meeting) most of the experiments in 2008 were successful and some used for the first time the bunched beam from the ISCOOL device. In 15 runs the RILIS was used with in total more than 2000 hours of RILIS operation for the year 2008. It was pointed out that the new solid state lasers were operational and showed a higher ionization efficiency. For REX-ISOLDE seven runs were scheduled and five of those were very successful, mainly Coulomb excitation experiments and for the first time the application of two-neutron transfer. Besides the busy on-line runs, several on- and off-line tests had been pursued including in-trap decay and mass-resolving tests in REX-TRAP. In general, the performance of the targets was very good. However, some technical problems and broken target units led to the loss of beam time. The final numbers for the 2008 campaign will be given at the next meeting.

The Committee was then informed on new and closed ISOLDE experiments. The following experiments were closed by the users: IS360, IS386, IS412, IS421, IS428, IS436. The experiment IS406 was closed by the INTC after evaluation of the submitted status report. In 2008, 12 new experiments have been approved by the Research Board so far: IS465-IS476. In addition new experimental setups will be installed at ISOLDE during the upcoming shutdown

period: the CRIS beam line for laser spectroscopy and a beta-NMR setup for the investigation of polarized beams.

The Physics Coordinator concluded with an overview of the RIB shift evolution over the last years. There seems to be an upwards trend for proposed and approved INTC RIB shifts over the last years. While the total number of remaining approved shifts has declined in the last years down to 700 shifts in the beginning of 2008, the number of requested RIB shifts increased significantly in 2008 as compared to the last three years. The number of delivered shifts is stable at around 300 shifts whereas the number of scheduled shifts declined slightly in the last two years, mainly due to the installation and machine development for the ISCOOL buncher. The draft schedule for the CERN accelerator complex for 2009 foresees a running period of about 31.5 weeks for ISOLDE, starting on April 6, 2009. Thus it might be possible to schedule more experiments as compared to 2008 (if resources are available) and to avoid a possible backlog of shifts.

n_TOF Status Report

The n_TOF representative, Paolo Cennini, gave a status report on the new n_TOF target and the planned startup. He presented a list of milestones towards the restart of the facility which is planned in 2008. This included the removal of the old target unit and a detailed investigation. The main problems seemed to be pitting corrosion at the region of the proton impact, mechanical instability of the separate lead blocks due to the modular assembly, and insufficient cooling due to hindered water flow caused by the target shape.

The pitting corrosion problem was studied in detail, especially the water chemistry at high temperatures which leads to a change of the oxidation state of Pb and therefore to the formation of hydroxides. All data obtained with the previous target helped in the understanding of the target degradation and to have a better design of the new target, especially with respect to the improvement of the target cooling.

The conceptual design, which was subject to an external panel review, foresees a new pressurized vessel which is lowered into the existing pool. The cooling water is provided from the top and should circulate with a much better flow to allow for a better cooling. In addition, an additional moderator is planned at the exit side of the target. The new target design was then studied in different simulations, also with respect to activation by the proton beam.

The Committee was informed on the present status of the installation of the new target at the PS complex. For the first tests the target area ventilation will not be implemented in agreement with CERN Radioprotection. It is foreseen to have the full ventilation system running after the shutdown 2008/2009. In conclusion, the facility is ready to take the first test beam in 2008.

The following proposals, addenda and status reports were then presented:

1. **CERN-INTC-2008-035 and INTC-P-249,** *n_TOF: New target commissioning and beam characterization*, José Luis Taín

2. **CERN-INTC-2008-037 and INTC-P-250**, *Charge radii of magnesium isotopes by laser spectroscopy: a structural study over the sd shell*, Deyan Yordanov

3. **CERN-INTC-2008-038 and INTC-P-251,** *The role of In in III-nitride ternary semiconductors*, Katharina Lorenz

4. **CERN-INTC-2008-039 and INTC-P-252**, *Coulomb excitation of neutron-rich ^{28,29,30}Na nuclei with MINIBALL at REX-ISOLDE: Mapping the borders of the island of inversion***,** Peter Reiter

5. **CERN-INTC-2008-041 and INTC-P-253,** *Measurement of the magnetic moment of the 2^+ state in neutron-rich radioactive ^{72,74}Zn using the transient field technique in inverse kinematics*, Andrea Jungclaus

6. **CERN-INTC-2008-040 and INTC-P-166-ADD-1**, *Magnetic moments of Coulomb excited 2^+_1 states for radioactive beams of ^{132,134,136}Te and ^{138}Xe isotopes at REX-ISOLDE*, Joerg Leske

7. **CERN-INTC-2008-044 and INTC-P-235-ADD-1**, *Addendum to the ISOLDE Proposal IS466: Identification and systematical studies of the Electron-Capture Delayed Fission (ECDF) in the lead region, Part II: ECDF of 178,182Tl*, Andrei Andreyev

CLOSED SESSION

Tuesday 4 November 2008 at 8:30 h, room 60-6-002

Present: Y. Blumenfeld, M. Doser, M. Fanciulli, P.-H. Heenen, A. Herlert (Secretary), M. Huyse (Chairman), R. Julin, H. Leeb, M. Lindroos, P. Roussel Chomaz, V. Vlachoudis, U. Wahl

Apologies: J. Billowes, Ch. Scheidenberger, N. Orr

1. INTRODUCTORY REMARKS

The Chairman opened the meeting and welcomed the new Committee members Patricia Roussel Chomaz and Nigel Orr, who replace Philippe Chomaz and Yorick Blumenfeld. He continued with a report from the Research Board meeting which took place on May 28, 2008. All experiments and RIB shifts recommended in the last INTC meeting have been approved. The Committee was also informed on the discussion of the status of the waste disposal of old target units and that 60 more free places are available at the ISR area, which will be sufficient for at least two more years of ISOLDE operation. As there is no means of dismantling the old target units, a plan for the longer term waste management should be put into place, e.g. the installation of a hot cell. It was also pointed out that CERN management requested a written report on the status of HIE-ISOLDE, as 50% of the required external funds have been collected. Mats Lindroos was asked by the ISOLDE Collaboration to coordinate the writing and the report should be submitted for the next Research Board meeting in December 2008.

The provisional dates for the upcoming INTC meetings were then fixed:

16 - 17 February 2009

18 - 19 May 2009

16 - 17 November 2009

The Chairman introduced the procedure to the new members and reiterated that solely a unique and well founded physics case should be taken as a criterion to recommend RIB shifts. The number of RIB shifts might be reduced and discussed, taking into account recent yield information and radioprotection or other safety issues. The priority or ordering of experiments is not to be discussed at the INTC.

It was pointed out by the Committee that downloading of INTC documents was rather difficult, especially after changing the login procedure of the CDS system. The INTC Secretary will look into this problem until the next meeting.

2. MINUTES OF THE LAST INTC MEETING

The minutes of the 31st INTC meeting held on 19 and 20 May 2008 were approved without amendments.

3. REPORT ON COMPLETED AND INACTIVE EXPERIMENTS

The status of inactive experiments was discussed including the status of the MISTRAL experiment (**IS436**). The Committee was informed and **took note** that the Spokesperson of MISTRAL, David Lunney, had submitted a status report (CERN-INTC-2008-033/INTC-SR-011) with which he **closed** the experiment. In addition, the experiment **IS421** was **closed** by the Spokesperson Ari Jokinen before the November INTC meeting. The ISOLDE Physics Coordinator then gave an overview of further inactive experiments and the INTC **decided to close** the following experiments:

IS419 (P171: *Measurement of Gas and Volatile Elements Production Cross Section in a Molten Lead-Bismuth Target*)

IS423 (P172: *Coulomb excitation of a neutron-rich ^{88}Kr beam-search for mixed symmetry states*)

4. STATUS OF ISOLDE

The Committee took note on the successful physics program at ISOLDE. The ISOLDE physics coordinator reviewed the RIB shift evolution in the last years and the Committee expressed some concern of a possible backlog of shifts in the future. The Committee was informed that in 2009 the running period will be longer and more experiments can be scheduled. The situation will be again discussed in the next meeting as beam time requests will be available and a more accurate assessment can be done. It was decided that the Committee will still judge submitted proposals solely on the physics case and feasibility. The ISOLDE Physics Coordinator shall report on the shift evolution and the shift backlog in the following meetings and further action by the Committee will be discussed upon the results.

5. STATUS OF N_TOF

The Committee took note on the status report and is looking forward to the first tests with the new target. It was pointed out that the performance of the facility, after the long stop and the installation of the new target unit with all its changes, has to be tested before new physics experiments can be performed. The Committee was further informed that the present cooling circuit is not the final version and that for the first test this year a reduced proton beam intensity is foreseen in accordance to an agreement with the Radioprotection group. During the following shutdown the full ventilation system will be installed to allow n_TOF the operation at full intensity. The Committee showed concern on the availability of proton pulses for the envisaged tests and already approved n_TOF experiments and whether running n_TOF will have an impact on the number of protons delivered to ISOLDE.

6. DISCUSSION ON THE OPEN SESSION AND ON LETTERS OF INTENT

The proposals presented during the open session as well as submitted letters of intent were then discussed:

CERN-INTC-2008-035/P-249, *n_TOF: New target commissioning and beam characterization*

The proposal aims at the test and the characterization of the new target which was recently installed at the n_TOF facility. The new target is ready for initial tests in 2008 and for full operation next year. All experiments which will be carried out at n_TOF in the future require a full characterization of the target, i.e., a measurement of the neutron yield, fluence, beam profile, etc. The Committee thus pointed out the importance of these first calibration measurements and that only the physics aspects would be taken into account - any safety aspect should be discussed separately. The proposed tests are similar to the ones done for the previous target unit and it is planned to compare the results with simulations. Especially the test of a new extra moderator and to find the best material requires additional beam time. The Committee **recommend** for approval by the Research Board a total number of **2.45×10^{18} protons** for the planned tests as indicated in the proposal. In addition, the Committee encouraged to perform simulations as vigorous as possible to fully understand the target behavior and a status report is requested once the target tests are complete.

CERN-INTC-2008-037/P-250, *Charge radii of magnesium isotopes by laser spectroscopy: a structural study over the sd shell*

The experiment proposes to measure the charge radii of Mg isotopes. The Committee found the physics case of high interest and the experimental method well founded. It is planned to apply two complementary techniques, fluorescence and beta-NMR detection, for which the COLLAPS group has a strong experience. The Committee decided to **recommend** for approval by the Research Board **10 shifts** for the neutron deficient Mg isotopes and **2 additional shifts** for the neutron-rich Mg isotopes, which will be added to the already approved 12 shifts of IS427. The Committee strongly suggested to analyze the data with respect to the shell model aspect and encouraged in general to ask for further theoretical support to obtain a broader view on the results.

CERN-INTC-2008-038/P-251, *The role of In in III-nitride ternary semiconductors*

The proposal is directed towards the investigation of the role of In in the efficiency of luminescent devices based on group III-nitride ternary semiconductors. The Committee found the physics case interesting and well founded, especially with respect to the unusual temperature behavior in the PAC measurements. However, it was pointed out that for these systems some work was already done in the past. Nevertheless, novel results are expected as previous experiments concentrated on only one case. The envisaged experiments could shed a light on the question whether In is indeed the cause of the luminescence mechanism. It is also of importance to investigate the after-effects of electron capture and to test if it is more an artefact of the measurements technique. The Committee **recommended** for the approval by the Research Board **20 shifts** and requested a status report after the successful data taking in order to request additional 8 shifts for the ^{111m}Cd beam if required. The Committee strongly suggested to check for the possibility of efficient beam sharing with other experiments.

CERN-INTC-2008-039/P-252, *Coulomb excitation of neutron-rich ^{28,29,30}Na nuclei with MINIBALL at REX-ISOLDE: Mapping the borders of the island of inversion*

The aim of the proposed experiment is to study the properties of neutron-rich sodium nuclei related to the island of inversion using Coulomb excitation at REX-ISOLDE. The Committee found the physics case well founded and the expected results on the single particle structure are needed as present calculations are not satisfactory. The proposed Na isotopes are the best candidates to provide the required information. The Committee pointed out that in the case of ^{28}Na a measurement of a 55-keV gamma-ray transition is needed, which might require additional detectors. However, as shown before, the measurement at these low energies should be possible with the presently installed Ge detectors of MINIBALL, especially due to the low background at REX-ISOLDE. The Committee **recommended** for approval by the Research Board **24 shifts**.

CERN-INTC-2008-041/P-253, *Measurement of the magnetic moment of the 2^+ state in neutron-rich radioactive ^{72,74}Zn using the transient field technique in inverse kinematics*

The proposal intends to determine the sign and the magnitude of the g-factors of the first 2^+ states in ^{72,74}Zn for which Coulomb excitation and the transient field technique will be applied. The envisaged method is the same as used in the experiment IS415, which asked for an addendum at the present meeting. The Committee found the physics case for Zn as very important since various model predictions are not conclusive. The experimental method should be sensitive enough to obtain information on the single particle structure and to constrain the

model space and to disentangle different theories. Compared to the other proposed experiment on Xe isotopes, the energy range just below the Coulomb barrier is advantageous. The Committee found the measurement technique very interesting and of importance for future experiments at REX-ISOLDE. If was also stressed that this technique is complementary to a recent experiment on ^{72}Zn at GANIL as the energy ranges are different. The yield for the proposed Zn isotopes and the REX-ISOLDE efficiencies were considered to be too conservative and the number of shifts was reduced to accommodate recently obtained values. The Committee decided to **recommend** for approval by the Research Board **21 shifts**.

CERN-INTC-2008-040/P-166-ADD-1, *Magnetic moments of Coulomb excited 2^+_1 states for radioactive beams of ^{132,134,136}Te and ^{138}Xe isotopes at REX-ISOLDE*

The aim of the proposed experiment is to continue the measurement of g-factors of the first excited 2^+ states of Te and Xe isotopes using the Transient Field method. This proposal is similar to the one presented for Zn isotopes (P253) and the Committee found the physics case well motivated, especially since theoretical predictions deviate quite a lot. The experimental method using MINIBALL detectors in order to be sensitive to the angular distribution is very nice, however, it would be better to have Compton suppression. The Committee expressed some doubts on the experimental setup, especially on the sensitivity to the choice of the material thicknesses but it was concluded that it is very important to test the experimental technique in addition to previous measurements with stable beam. The Committee **recommended** for approval by the Research Board **6 shifts** in addition to the 6 remaining shifts in order to finish the measurements program for ^{138}Xe and strongly suggested to submit a new proposal for the Te isotopes, especially for the case of ^{132}Te, in which the physics results for the Xe isotopes should be presented as well as results on yield checks for Te isotopes.

CERN-INTC-2008-044/P-235-ADD-1, *Addendum to the ISOLDE Proposal IS466: Identification and systematical studies of the Electron-Capture Delayed Fission (ECDF) in the lead region, Part II: ECDF of 178,182Tl*

This addendum to the proposal P-235 asks for a continuation of the investigation of electron-capture delayed fission (ECDF) in the mass region of neutron-deficient Pb isotopes. ECDF is a very appealing method to determine fission parameters for the envisaged mass region: the mean kinetic energy mass distributions and the fission barrier heights. The Committee pointed out that in the original proposal it was foreseen to measure ^{178,180,182}Tl, but during the scheduled run ^{180}Tl was investigated only, as asymmetric fission was observed being considered as a new phenomenon. The Committee took note on the obtained results, however, pointed out that it is not unexpected to observe asymmetric fission since high spin states are populated. The Committee further stressed, that it was not clear from the presented results, if the yield for ^{178}Tl will be large enough to get sufficient statistics and if the observed asymmetric fission can also be clearly identified for low statistics. Nevertheless, the physics case is very interesting and with the planned measurement of the hyperfine structure the spin can be determined which is important to conclude on the obtained results. The Committee decided to **recommend** for approval by the Research Board **16 shifts** and suggested to concentrate on the case of ^{182}Tl rather than ^{178}Tl.

CERN-INTC-2008-034/I-079, *g-factor measurements at REX-ISOLDE*

The presented letter of intent aims at the installation of a new experimental setup to perform measurements of g-factors of isomeric states in exotic nuclei. The Committee found the envisaged experimental program of high interest, although no real example for a future

measurement was given in the letter. The Committee **endorsed** the letter of intent and supported the installation of a test setup. The ISOLDE Physics Coordinator was asked to check the allocation of space behind the REX-LINAC in the upcoming shutdown and the next running period as the new setup should not hamper other approved REX-ISOLDE experiments.

7. DISCUSSION ON LETTERS OF CLARIFICATION

In addition to proposals, status reports and letters of intent, letters of clarification were submitted in order to address questions raised by the Committee in previous meetings on already submitted proposals.

CERN-INTC-2008-036/CLL-003, *Approaching the r-process "waiting point" nuclei below ^{132}Sn: quadrupole collectivity in ^{128}Cd - Letter of Clarification*

The original proposal P226 asked for ^{128}Cd beam in order to study the quadrupole collectivity with the MINIBALL detector array using safe Coulomb excitation and to measure the transition strength B(E2) between the ground state and the first excited 2^+ state. The physics case was endorsed in the May meeting of the INTC, however, the Committee had asked for a yield check for ^{128}Cd before shifts could be recommended. The yield measurements were performed in May 2008 for a UC_x target equipped with a quartz transfer line for alkali metal suppression. From these data it was concluded that the initial yield estimate was realistic and sufficient to do the experiment at REX-ISOLDE. The Committee thus decided to **recommend** for approval by the Research Board **24 shifts.**

CERN-INTC-2008-042/CLL-004, *^{72}Kr beam development for Shape determination in Coulomb excitation of ^{72}Kr*

In the proposal P228 a ^{72}Kr beam was requested to perform measurements at MINIBALL related to the determination of the shape of low- and high-lying states. In the INTC meeting of May 2007, the Committee had decided to endorse the physics case and supported the development of a sufficiently intense ^{72}Kr beam at ISOLDE. Several off-line and on-line tests in 2008 were performed, including also the new target material Y_2O_3 and an improved MiniMono ECR ion source. With the measured yields the experiment seems to be feasible and the Committee decided to **recommend** for approval by the Research Board **30 shifts**.

CERN-INTC-2008-043/SR-012, *Status report: Shape coexistence measurements in even-even neutron-deficient Polonium isotopes by Coulomb excitation using REX-ISOLDE and the Ge MINIBALL array*

This status report, which is rather a letter of clarification, summarizes the tests that were performed in 2008 to study the release and yield characteristics of Tl in order to obtain a pure Po beam for the envisaged proposal P247. This proposal is directed towards the investigation of shape-coexistence in ^{198,200,202}Po using MINIBALL and safe Coulomb excitation. In the INTC meeting in May 2008 the Committee had endorsed the physics case but requested a test of Po and Tl yields as well as their release properties. The obtained data confirm the feasibility of the proposed experiment and the Committee thus decided to **recommend** for approval by the Research Board **27 shifts**.

Out of the **203** radioactive beam shifts requested to the INTC a total of **180** have been recommended for approval by the Research Board.

8. DATES OF NEXT MEETING

The next INTC meeting will take place on **Monday 16 and Tuesday 17 February 2009**. The deadline for submission of proposals is **Monday 19 January 2009**.

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